REMARKS

The Examiner is thanked for the clarity and conciseness of the Office Action and for the citation of the references which have been studied with interest and care.

Claim Objections

In paragraph 2 of the Office Action, claim 7 was objected to based on the assertion that the language "at least as small as" appears to have incorrect grammar. Claim 7 (Original) recited "a line gap which is at least as small as 10 µm." In response to the Examiner's concern, Applicants have amended claim 7 to recite "a line gap 10 µm or smaller" -- language that the specification clearly supports. Withdrawal of this objection is respectfully requested.

In paragraph 2 of the Office Action, claim 32 was objected to, but no informalities in that claim were indicated. Accordingly, it appears that the Examiner inadvertently made reference to claim 32 in this paragraph.

Claim Rejections -- 35 USC § 112

Claims 5, 9 and 13 were rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 5, it was asserted that the language "in consideration of <u>how well</u> the at least one conductive layer absorbs radiation at particular wavelengths" (emphasis added) is subjective, vague and indefinite. Although it is respectfully submitted that the language in claim 5 (Original) is not subjective, vague and indefinite, claim 5 has been amended to recite "selecting the excimer laser depending upon radiation absorption of the at least one conductive layer at particular wavelengths." *See, e.g.*, FIGs. 2 and 3 and accompanying text. No new matter has been added.

With respect to claim 9, it was asserted that the language "swells a <u>desired amount</u>" (emphasis added) is subjective, vague and indefinite. Although it is respectfully submitted that the language in claim 9 (Original) is not subjective, vague and indefinite, claim 9 has been amended in response to the Examiner's concern, describing the swelling of the at least one functional layer with greater particularity. No new matter has been added.

Claims 13 and 15 have been canceled.

Claim Rejection - 35 USC § 102

Claims 1-4, 16-18, 22-23, 25-27, 30 and 32-33 were rejected under 35 U.S.C. 102(b) as being anticipated by Hichwa et al. (US 5,724,175).

Hichwa et al. pertains to successive depositions of conductive layers and laser etching -- an approach not practical for high-speed patterning. In contrast with the slow direct beam impact approach of Hichwa et al., the method of the present invention employs a projection-type excimer laser system to rapidly and precisely ablate a pattern into at least one conductive layer of a multilayered conductor/plastic substrate structure. As discussed below, Hichwa et al. clearly fails to disclose or suggest employing an excimer laser of a projection-type ablation system to ablate portions of the at least one conductive layer.

Hichwa et al. discloses an electrochromic device manufacturing process using laser ablation techniques to pattern an electrochromically active area by irradiating specific areas of the electrochromic device with laser pulses. "The number of pulses necessary to cut to a specific depth is dependent on a number of variables including, the wavelength of the laser used and the materials being delineated." [Hichwa et al., column 9, lines 42-45.]

> The wavelength of the laser pulse used depends on the materials to be delineated and the depth of delineation desired. The laser typically used has a wavelength in the range between 100 nm and 400 nm, and, in use, is focused to a desired energy density. It is noted that the size of the delineation is controlled by varying the size of the laser beam. It is readily understood that the laser used in the ablation patterning process can be programmed to strike a specific area of the electrochromic device so as to delineate any desired pattern.

[Hichwa et al., column 7, lines 16-25.] Hichwa et al. also discloses that, in a preferred embodiment, "the laser is an ultraviolet eximer laser, such as XeCl (308 nm), KrF (248 nm) or ArF (193 nm)." [Hichwa et al., column 7, lines 30-35.]

With respect to claim 3, the Examiner interpreted that the wavelength of 193 nm read on the limitation "wavelength in the mid-UV range". The foregoing interpretation is respectfully traversed for the reason that the term "mid-UV" is well known in the art to mean around 290-320 nm. *See*, University of Washington document (attached).

For these reasons and for the reasons discussed below, it is respectfully submitted that the collective teachings of the cited references fail to disclose or suggest Applicants' method for

patterning a multilayered conductor/substrate structure employing a projection-type excimer laser system as recited in amended claim 1 and in the claims dependent therefrom.

Claim Rejections - 35 USC § 103

Claims 5 and 28-29 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Chrisey et al. (US 6,177,151).

Chrisey et al. discloses a device for depositing a transfer material onto a receiving substrate. A laser transparent target substrate initially carries the transfer material. More specifically, the target substrate has a coating that comprises a mixture of the transfer material to be deposited and a matrix material.

> The matrix material is a material that has the property that, when it is exposed to pulsed laser energy, it is more volatile than the transfer material. The source of pulsed laser energy is be positioned in relation to the target substrate so that pulsed laser energy is directed through the back surface of the target substrate and through the laser-transparent support to strike the coating at a defined location with sufficient energy to volatilize the matrix material at the location, causing the coating to desorb from the location and be lifted from the surface of the support. The receiving substrate is positioned in a spaced relation to the target substrate so that the transfer material in the desorbed coating can be deposited at a defined location on the receiving substrate.

[Chrisey et al., Abstract.] "The composition of the laser transparent support is selected in accordance with the particular type of pulsed laser to be used. For example, if the laser is a UV laser, the laser transparent support may be a UV-transparent material including, but not limited to fused silica or sapphire." [Chrisey et al., column 9, lines 50-54.]

Thus, while Chrisey et al. does indeed disclose that the absorption of UV laser radiation is a factor to be considered in selecting the matrix material, this reference provides no disclosure or suggestion of irradiating -- with UV radiation -- a multilayered conductor/substrate structure which includes a plastic substrate and at least one conductive layer overlying the plastic substrate.

Moreover, according to Chrisey et al., "[i]t is an object of the present invention to provide devices, materials and methods for depositing a material on a substrate wherein a pattern can be created directly on the substrate <u>without the use of a mask</u>." [Chrisey et al., column 3, lines 12-15 (emphasis added).] To this end, in Chrisey et al., laser energy is directed through the back

surface of the target substrate and through the laser-transparent support to strike the coating. Applicants' method for patterning a multilayered conductor/substrate structure is an entirely different process; and Chrisey et al. clearly teaches away from irradiating the multilayered conductor/substrate structure as claimed by Applicants.

Claims 6, 7 and 31 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Mayer (US 4,752,455).

As with Chrisey et al., Mayer pertains to directing laser energy through a substrate of transparent material (such as glass) to a target film positioned on the substrate at a sufficient intensity and for a sufficient duration to vaporize the film. With reference to FIG. 1, Mayer discloses that: "Laser intensities of 10^9 to 10^{12} W/cm^2 at a pulse duration of between 10^{-10} and 10^{-8} sec would heat the illuminated section of film 24 to a temperature of between 2000° and 100,000° K." [Mayer, column 3, lines 65-68.] With reference to FIG. 2, Mayer discloses that: "A mask 39 having the desired deposition pattern 41 stencilled therein is positioned to intersect the laser beam, allowing only a portion of the laser energy corresponding to pattern 41 to be focused onto target 20." [Mayer, column 4, lines 12-16.]

Mayer clearly fails to disclose or suggest irradiating -- with UV radiation -- a multilayered conductor/substrate structure which includes a plastic substrate and at least one conductive layer overlying the plastic substrate. The mere fact that Mayer teaches the use of a mask in conjunction with a "laser-explosive vapor deposition technique" does not, it is respectfully submitted, disclose or suggest irradiating Applicants' multilayered conductor/substrate structure in the manner claimed.

Claims 12-15 and 19 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Nowak (US 6,025,110).

As a preliminary matter, there is no recitation of an "excimer laser" in Nowak and no disclosure of a projection-type ablation system. What Nowak does disclose is that lasers in the UV range can be employed and, with reference to FIG. 1, that: "Laser 105 preferably emits a beam focused to a controlled-diameter spot (typically between 0.1 mil (i.e., 0.0001 inch) and 10 mils in diameter, and which varies by no more than 0.1% in diameter). Representative laser powers range from 0.01 to 5 watt/cm.sup.2, with 0.5 watt/cm.sup.2 being preferred." [Nowak, column 3, lines 35-43.] The movement assembly 107 scans the laser 105 over the laser ablation transfer (LAT) material 110.

Nowak does not disclose a "roll-to-roll production process" (e.g., using a web-type substrate). Rather, Nowak teaches a mask in the form of a roll. A roll-to-roll (in line) production process is different from the Nowak method of fabricating three-dimensional objects using ablation transfer, and fundamentally incompatible with the Hichwa et al. successive steps of formation of conductive layers and selective laser ablation of each layer.

Nowak discloses a method and apparatus for generating three-dimensional objects using ablation transfer. A three-dimensional object is fabricated employing a selective layer-by-layer transfer of material from a "laser-ablation transfer" (or LAT) material. Referring to FIG. 3, exemplary LAT material comprises a carrier layer 300, an ejection layer 305, and a transfer layer 310. The carrier layer 300 is a mechanically and thermally stable film, e.g., a polymeric film such as MYLAR polyester film, that is transparent to the energy emitted by the laser 105 (FIG. 1). The purpose of the ejection layer 305 is to produce a sudden but controlled burst of gas upon exposure to the beam of laser 105. The rapidly expanding gas ejects a plug of transfer layer 310 which generally comprises one or more thermoplastic polymers. The ejected transfer material solidifies on the receiver or on a previously applied layer of transfer material. Sequential irradiations of fresh ablation-transfer carrier material, each according to a two-dimensional pattern corresponding to one of the contiguous layers of the three-dimensional object, result in depositions that gradually build up into the three-dimensional object.

Nowak teaches employing a laser to eject melted plugs of thermoplastic polymer(s) from LAT material 110 in roll or tape form for the purpose of sequentially forming the layers of a three-dimensional object. Accordingly, it is respectfully submitted that Nowak is not at all relevant to the claimed invention. Even if Nowak were properly combined with Hichwa et al., the combined teachings of these references still fail to disclose or suggest the claimed subject matter for the reasons discussed above.

Claims 20-21 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Kinoshita et al. (US 6,300,594).

Claim 20 has been amended to recite "wherein the plastic substrate comprises polyethylenenapthalate (PEN) or polyethersulphone (PES)." Kinoshita et al. does not disclose or suggest a plastic substrate comprising either of these materials.

Claim 24 was rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Logan et al. (US 4,093,345).

Logan et al. discloses an optical modulator comprising: a first semiconductive epitaxial layer..., a second semiconductive epitaxial waveguide layer for propogating optical radiation..., and a (polycrystalline indium-tin oxide) third layer on a first surface portion of a plateau portion of the second epitaxial layer.

The process disclosed in Logan et al. for fabricating the optical modulator involves using liquid phase epitaxy for growing the first and second epitaxial layers, depositing the indium-tin oxide layer, and using an etching solution (e.g., hydrochloric acid) to selectively etch the indium-tin oxide layer into the desired rib pattern. This process is completely different from Applicants' claimed method for patterning a multilayered conductor/substrate structure and provides no disclosure or suggestion of: providing a multilayered conductor/substrate structure which includes a plastic substrate and at least one conductive layer overlying the plastic substrate; or employing an excimer laser system of any type to ablate portions of a polycrystalline indium-tin oxide layer.

The rejection under 35 U.S.C. § 103 is improper for several reasons. First, as the Federal Circuit reiterated once again in *In re Lee*, 61 USPQ2d 1430, 1433 (Fed. Cir. 2002), "a showing of a suggestion, teaching, or motivation to combine the prior art references is an 'essential component of an obviousness holding.'" [Citations omitted.] The burden of showing obviousness may be satisfied "only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references." [Id. at 1434, citations omitted.] Here, there is absolutely no reason, other than a hindsight attempt to replicate the claimed combinations, to combine the cited references in the manner proposed in the Office Action.

Second, even if the cited references are ultimately determined to be properly combined, their collective teachings nevertheless fail to disclose or suggest: providing a multilayered conductor/substrate structure which includes a plastic substrate and at least one conductive layer overlying the plastic substrate, the at least one conductive layer including a polycrystalline ITO layer; and employing an excimer laser of a projection-type ablation system to ablate portions of the at least one conductive layer.

Claims 8, 11, 34-43 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Graff et al. (US 6,492,026) in view of each other.

With respect to claim 43, an example embodiment of the "additional functional layer" is shown in FIG. 5 of Applicants' specification. Although Graff et al. does indeed disclose

smoothing and barrier layers for high glass transition temperature (Tg) substrates, the cited reference does not appear to disclose providing a side of the plastic substrate that faces away from the at least one conductive layer (in FIG. 5, the underside of the plastic substrate) with "an additional functional layer" that serves to provide structural protection and/or environmental protection for the plastic substrate. For the reasons discussed above, the collective teachings of the cited references fail to disclose or suggest these claims.

Claims 9-10 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hichwa et al. in view of Graff et al. and further in view of Dunsky et al. (US 6,433,301).

Dunsky et al. addresses the compromises inherent in using a TEM_{00} laser beam with a clipped-Gaussian irradiance profile to drill vias in a workpiece. Referring to FIG. 3 of Dunsky et al., the illustrated workpiece 22 includes metal layers 24, 28 and dielectric layer 26 therebetween. "A through-hole via 20a typically penetrates all layers and materials of workpiece 22 from its top 42 to its bottom 44. Blind via 20b does not penetrate all layers and/or materials." [Dunsky et al., column 5, lines 32-34.]

> Whether punching or nonpunching to create blind vias 20b, the metal layer is removed with a first laser output having a power density sufficient to ablate the metal. Then, the dielectric layer is removed with a second laser output having a lower power density that is insufficient to ablate the metal, so only the dielectric is removed and the underlying metallic layer is not damaged. Thus, the two-step machining method provides a depthwise self-limiting blind via because the second laser power output is insufficient to vaporize the metallic bottom layer, even if the second laser power output continues after the dielectric material is completely penetrated.

[Dunsky et al., column 10, lines 48-59.]

An important aspect of Applicants' method for patterning a multilayered conductor/substrate structure is that the at least one functional layer (intermediate the at least one conductive layer and the plastic substrate) serves multiple functions. In addition to comprising an insulating material, the at least one functional layer also functions as a mechanism to assist in the removal of the at least one conductive layer during the ablation process. The swelling of the at least one functional layer in effect supplements the energy of the laser pulses.

Claim 9 has been amended to recite additional details pertaining to the assist mechanism functionality of the at least one functional layer. For the reasons discussed above, Dunsky et al. and the other cited references clearly fail to disclose or suggest Applicants' method for patterning a multilayered conductor/substrate structure as claimed.

CONCLUDING REMARKS

Applicants submit that the application is in condition for allowance. Concurrence by the Examiner and early passage of the application to issue are respectfully requested.

Any fees that are required in connection with this communication and not specifically provided for herewith are authorized to be charged to deposit account no. 50-0651. Any overpayments are also authorized to be credited to this account.

Respectfully submitted,

June 5, 2003

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